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ABSTRACT

The Emergency School Aid Act (ESAA) Math Component was designed to improve mastery of math basic skills among the lowest achieving math students in 8 desegregating public junior high schools, junior-high-level grades in 6 nonpublic schools, and the ninth grade in one public high school. The Math Component consisted of 25 teacher aides, a part-time Math Coordinator, a curriculum of workbooks and tests of the Mathematics Basic Skills Development Project (MBSDP). The Math Component not only met, but surpassed its two objectives for mastery gain among remedial students. Objective I required 50 percent of ESAA students to maintain or improve their relative standing (percentile) among same-grade peers from fall to spring on the Minneapolis Arithmetic Computation Test (MACT). About two-thirds of the students met this objective, and therefore had a spring percentile rank which was the same as, or higher than, their fall rank. The interpretation of these MACT gains is, however, clouded by a possible regression artifact. Objective II required 50 percent of the students to earn "Mastery-Gain Points" on MBSDP units at the rate of 40 per year. Again, two-thirds of the students met this objective. Recommendations for program improvement included: (a) a more efficient system for MBSDP materials distribution; (b) a formal commitment by participating schools to use ESAA aides, to use MBSDP materials, and to organize participating teachers and staff; (c) a full-time coordinator; and (d) careful planning to avoid unintended overrepresentation of racial minorities in the ESSA Math Component. (Author/DEP)

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Minneapolis Public Schools

# The Mathematics Component of the Minneapolis Schools' 1973-74 Emergency School Aid Act Project: An Evaluation

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Contracted by the
Minneapolis Public Schools

Ideas expressed in this report do not necessarily reflect the official position of the Minneapolis Public School Administration nor the Minneapolis School Board.

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Research and Evaluation Department
Planning and Support Services Division

The Mathematics Component of the Minneapolis Schools' 1973-74 Emergency School Aid Act Project: An Evaluation

## Summary


The ESAA Math Component was designed to improve mastery of math basic skills among the lowest-achieving math students in 8 desegregating public junior high schools, junior-high-level grades in 6 non-public schools, and the ninth grade in one public high school. (See Page 1)

The Math Component consisted of 25 teacher aides, a part-time Math Coordinator, a curriculum consisting of the soft-cover workbooks and tests of the Mathematics Basic Skills Development Project (MBSDP), and a pre-service workshop on the use of these materials. Implementation of the program depended on the voluntary participation of 44 teachers of remedial math. The Math Component cost 13% of the total Minneapolis ESAA grant of $535,441. (See Pages 7-10, 17-21, 2)

During 1973-74 the Math Component aided the remedial instruction of about 1200 Minneapolis students, including about 120 lowest scorers in each public school on the fall Minneapolis Arithmetic Computation Test (MACT). (See Pages 11-15)

The evaluation studied those 1000 students for whom achievement data were available. The Minneapolis Public Schools contracted an independent evaluator to conduct this federally required evaluation. (See Page 2)

The Math Component not only met, but surpassed its two objectives for mastery gain among remedial students. Objective I required 50% of ESAA students to maintain or improve their relative standing (percentile) among same-grade peers from fall to spring on the MACT. About two-thirds of the students met this objective, and therefore had a spring percentile rank which was the same as, or higher than, their fall rank. The interpretation of these MACT gains is, however, clouded by a possible regression artifact. Objective II required 50% of the students to earn "Mastery-Gain Points" on MBSDP units at the rate of 40 per year. Again, two-thirds of the students met this objective. (See Pages 3-7, 21-25)

Three schools with higher MACT gains and MBSDP progress among their students, relative to three schools with lower gains, had ESAA math programs which (a) seemed better organized, (b) involved teachers more enthusiastic about teaching remedial math, (c) had teachers who were more favorable toward MBSDP materials, (d) used the ESAA math aides more efficiently. (See Pages 25-28)

Recommendations for program improvement included: (a) a more efficient system for MBSDP materials distribution; (b) a formal commitment by participating schools to use ESAA aides, to use MBSDP materials, and to organize participating teachers and staff; (c) a full-time coordinator; and (d) careful planning to avoid unintended overrepresentation of racial minorities in the ESAA Math Component. (See Pages 28-29)

The evaluator believes the program worthy of re-funding. (See Page 29)


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December 1974

Research and Evaluation Department

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# The Mathematics Component of the Minneapolis Schools' 1973-74 Emergency School Aid Act Project: An Evaluation

The Mathematics Component of the Minneapolis Schools' 1973-74 Emergency School Aid Act Project was designed to improve mastery of mathematics basic skills among junior high students with extremely poor math achievement. The staff of the Math Component consisted of 25 teacher aides and a six-tenths time Math Coordinator. The curriculum consisted of the consumable-booklet, instructional units of the Minneapolis Schools' Mathematics Basic Skills Development Project (MBSDP). The MBSDP units were written by a team of Minneapolis teachers. The Project and the development of the units, funded under Title I of the Elementary and Secondary Education Act, are described in a 1973 paper by Hartwood and Taylor.

Although the Math Component did not hire teachers, a total of 44 Minneapolis teachers, in both public and private schools, participated in the 1973-74 ESAA Math Component by using both the services of the ESAA math aides and the units of the MBSDP. The ESAA Math Coordinator, who participated in developing the MBSDP units, consulted with teachers seeking to make the best use of ESAA aides and the innovative materials.

A pre-service workshop on the use of the curriculum materials was attended by all aides and by 8 of every 10 participating teachers.

During 1973-74 the Math Component aided the remedial instruction of approximately 1200 students in public and nonpublic Minneapolis Schools. This evaluation studies the gains in mathematics skill of approximately 1000 students who completed MBSDP units and/or took both pre- and posttest administrations of a standardized basic-math test.

Because the Emergency School Aid Act (1972; denoted hereafter as ESAA) was designed in part to help solve instructional problems that might arise from planned desegregation, the Math Component operated in those eight public junior high schools desegregating as of fall, 1973: Anthony, Bryant, Franklin, Jordan, Jefferson, Lincoln, Phillips, and Ramsey. (For an overview of the Minneapolis desegregation plan, see the summary published by the Minneapolis Public Schools, 1972.) The ninth grade in one public high school, North High, received ESAA math assistance. Junior-high-level grades in six nonpublic schools also participated in the Math Component in 1973-74: the seventh and eighth grades in Ascension, Holy Rosary, Incarnation, St. Joan of Arc, and St. Stephens; and the ninth grade at Regina High.

Background: The Minneapolis Schools' ESAA Project

The Math Component was one of three comprising the Minneapolis Schools' ESAA Project. The other Components provided remedial reading instruction and Desegregation Counselor-Aides for junior high students. The Counselor Aides were employed to prevent or reduce any racial conflict that might arise in the desegregating public junior highs. The original plans for each of the three Components are described in the proposal for Minneapolis' ESAA Project (Office of Planning, Development, and Federal Programs, 1973).

Among the three Components, the Math program was considered third in priority for funding, behind both Reading and Conflict Resolution (Counselor-Aides). The Math Component was also the least expensive, costing $60,957 in the public schools (and also taking a very small share of the $50,791 allotted to nonpublic schools for reading and math instruction). Of the total $535,441 in ESAA funds awarded to Minneapolis for 1973-74, approximately 13% went to the Math Component.

The priority of each Component for funding was determined by a vote of the ESAA Districtwide Advisory Committee, a group constituted in accordance with ESAA guidelines so as to (a) represent all major racial/ethnic groups in Minneapolis and (b) include teachers, students, parents, and members of community organizations promoting equality of opportunity.

ESAA evaluation. The ESAA-Project budget allotted a maximum of $10,000 for evaluation. These funds were used to study all three Components--Reading, Conflict Resolution, and Math. The evaluation was conducted by an independent contractor, a research psychologist selected by the Research and Evaluation Department of the Minneapolis Public Schools. Although the evaluator received technical consultation and clerical assistance from the Research and Evaluation Department, the evaluator was not a regular employee of the school district.

The relationship between ESAA and Title I assistance. Seven of the ESAA public schools--Bryant, Franklin, Jefferson, Jordan, Lincoln, Phillips, and North--also received federal aid in 1973-74 under provisions of Title I of the Elementary and Secondary Education Act. Title I funds are used to aid the compensatory education of disadvantaged students. ESAA funds, to aid desegregating school districts, are not necessarily earmarked for compensatory education, although they may be so used. In Minneapolis, the ESAA Project did, however, emphasize compensatory reading and math instruction. The ESAA students in these schools were a subset of Title I-eligible, disadvantaged students, consisting of the lowest achieving junior-high-age

students; namely, the lowest-achieving 125 students in math, and the lowest-achieving 125 students in reading. In short, in a school that received assistance from both ESAA and Title I, every ESAA student was a Title I-eligible student, but not every Title I student was an ESAA student.

The Organization of This Evaluation Report

The following sections of this report provide answers to four questions about the Math Component:

1. What were the objectives of the Component?

2. How did the Component operate? The answer to this question includes a description of the Math Component's curriculum, students, staff, and day-to-day operation. The actual operation of the Component is also compared to the original Project proposal's prescriptions for program operation.

3. Was the Component effective in meeting the objectives stated in the original Project proposal? Included in the answer to this question is a discussion of factors possibly accounting for differences among schools in their success in meeting Component objectives.

4. What recommendations should be made concerning (a) the improvement of Component operation and (b) the re-funding of the ESAA Math Component?

## THE OBJECTIVES OF THE MATH COMPONENT

The Math Component attempted, using math aides and MBSDP materials, to produce important gains in mathematics mastery among the poorest-achieving math students in each ESAA school. All students selected for the Math Component were to be two or more years below the level of math achievement expected for their grade level as of the start of the 1973-74 school year. The Component planned to serve 125 of these students in each public school and smaller numbers of these remedial students in each nonpublic ESAA school. Selection of students for the Math Component was based largely on a fall, 1973, administration of the Minneapolis Arithmetic Computation Test (abbreviated MACT; published by the Department of Mathematics, Minneapolis Public Schools, 1973b. (See pp. 11-17 for a more detailed description of the ESAA math students and their selection.)

The specific objectives of the Math Component were:

Objective I: 50% of the evaluation-eligible ESAA students who take both the fall, 1973, and spring, 1974, MACT will have a percentile rank in the spring which is the same, or higher than, their percentile rank in the fall.

"Evaluation-eligible" ESAA students were those lowest math-achievers who actively participated during 1973-74 in a math class which had both an ESAA math aide and MBSDP materials. Such students were "reasonably exposed" to the Math Component in that (a) they were enrolled in the ESAA-aided math class for at least one grading period (quarter or trimester) and (b) they attended at least half of the math-class sessions during the total of all 1973-74 grading periods they were enrolled in the math class.[1]

Objective I, in effect, stated that at least half of the evaluation-eligible ESAA students would maintain their relative position among peers, over time, in math achievement. The 33-item MACT defines math achievement as the student's ability to perform the four fundamental operations on whole numbers, fractions, decimals, and percents. Different, equivalent forms of the MACT were given to all Minneapolis public-school seventh and eighth graders in September, 1973, and May, 1974. Separate percentile norms for each grade level (seventh and eighth) were computed for each test administration, and are reproduced in this report as Appendix A. An ESAA student's raw score at each testing was referred to the appropriate citywide percentile norms. (Since no citywide ninth grade norms existed, the raw scores of ESAA ninth graders were referred to eighth grade norms.)

If ESAA students obtained the same MACT percentile in fall, 1973, and spring, 1974, the writers of Objective I apparently would infer both (a) that ESAA students had kept pace in math skills with their peers, and (b) that ESAA students had made the yearly amount of growth in math achievement currently expected from remedial Minneapolis math students at that grade level. Such inferences unfortunately would be erroneous. A later section of this report discusses the unavoidable effect of a regression artifact in boosting the pretest to posttest gain scores of students selected for their low pretest scores.

Objective II: 50% of the evaluation-eligible ESAA students will earn "Mastery-Gain Points" on MBSDP units at the rate of 40 or more per year, based on the total of those marking periods they were enrolled and attending half or more of their math classes.

[1] An ESAA student was "reasonably exposed" and therefore evaluation-eligible if, for example, the student attended 25% of the classes during the first grading period, 75% of the classes during the second grading period, and then dropped out of the ESAA math class or transferred to another school after the second grading period. (No provision was made in the evaluation for educational follow-up of ESAA students after they transferred to other ESAA or non-ESAA schools). A student who dropped out during a grading period was considered evaluation-eligible only if he/she had attended 50% or more of all class sessions held during the total of all enrolled grading periods, a total which includes the remaining class sessions in the grading period, after the student dropped out.

The units in the MBSDP curriculum are listed on Page 2 of Appendix B, which is the form used to record for each student (a) gains in math achievement as measured by MACT scores and progress on MBSDP units and also (b) that information on class enrollment and attendance needed to determine evaluation eligibility.

Completing an MBSDP unit. Each unit listed in Appendix B is preceded by a diagnostic pretest. The number of problems, ranging from 8 to 26, is the same for both the unit pretest and the unit posttest. If the student correctly answers 85% of the items assessing mastery of that unit, the student skips the unit. If the student does not show 85% mastery, then the student completes the 20-50 page linear-program unit-booklet. Each unit-booklet is divided into parts that are 3-8 pages long. The student checks his/her answers after each part. On completion of the booklet, the student takes one of three equivalent posttests (which are also equivalent to the diagnostic pretest). A student correctly answering 85% of the posttest problems moves on to the next unit. A student not achieving such mastery (a) completes additional materials (often including worksheets and puzzles), (b) receives individual help from the teacher or aide, and then (c) takes additional posttests until the 85%-correct criterion is met.

Unit difficulty. Each MBSDP unit is associated with an "estimated difficulty" rating. The difficulty ratings range from 6 for the easiest units (e.g., Fractions Unit 1, addition with like denominators) to 30 for the hardest (e.g., Division of Whole Numbers, Traditional Approach). The difficulty estimates for each unit were based on a consensus of the MBSDP authors and several math teachers familiar with the materials.

Mastery-Gain Points. Objective II, in effect, stated that at least half of the evaluation-eligible ESAA students would show "adequate gains" in mastery of math topics in which they formerly lacked competence. To document this type of math achievement, a point system was devised to assess each student's "mastery gain" after studying units of the MBSDP curriculum. After successfully completing a unit (answering 85% correct on a posttest), a student was awarded "Mastery-Gain Points," taking into account both (a) the "estimated difficulty" of the unit (see preceding paragraph) and (b) the student's score on the pretest for the unit.

For each unit, a student could earn the maximum "Mastery-Gain Points," equal in number to the unit's "estimated difficulty," only if the student

had an extremely low score on the pretest. Specifically, students with pretest scores of 0-34% correct answers earned the full number of Points when they completed the unit and passed the posttest. Students in the 35-64% range on the pretest earned two-thirds of the maximum Points allowable for that unit. Students with pretest scores of 65-84% earned only one-third of the maximum Points on unit completion. Appendix B includes the conversion table used to assign a student Mastery-Gain Points upon unit completion, based on the student's unit-pretest score.

Objective II considers a student to have made "adequate gains" if the student earned "mastery-gain points" at the rate of 40 per year. That is, those ESAA students enrolled for at least one grading period who attended 50% or more of the ESAA-aided math classes during the total period of their enrollment should earn points at the 40-per-year rate. An evaluation-eligible ESAA student enrolled in an ESAA-aided math class for one quarter should earn 10 mastery-gain points. A student enrolled and attending for one trimester should earn 13.3 points; for two trimesters, 26.7 points.

As an example of adequate gains, a student could earn 46 points in one year by completing the following units, having begun each unit with pretest scores in the 35%-64% range: Division of Whole Numbers, Traditional Approach (20 Mastery-Gain Points earned out of a possible 30); Fractions Concepts (10); Fractions Unit 1, addition (4); Fractions Unit 2, mixed-number addition (4); and Fractions Unit 3, subtraction (8).

How Objectives I and II Differ From Those Stated in the ESAA Project Proposal

The originally stated objectives of the Math Component required modification for the present evaluation. First, the original Objective I in the ESAA Project proposal stated, "50% of the ESAA students will show one or more years' growth, 25% will show 5-9 months' growth, and 25% will show less than 5 months' growth on the Minneapolis Arithmetic Computation Test given in fall, 1973, and spring, 1974" (p. 26). Minneapolis city-wide MACT norms are computed for each grade level, at each test administration. While the norms perhaps allow one to infer that a student has made a year's growth in computation skills (by maintaining his/her same percentile rank among same-grade peers from fall to spring), the MACT norms do not permit determination of "months' growth." Those portions of the originally stated objective that could not be measured were therefore deleted for the present evaluation.

Second, Objective II in the original proposal stated that "50% of the ESAA students will master at least two areas" and "25% will master one area, by reaching the 85% level on the criterion-referenced tests associated with the instructional units in each area" (p. 26). This second original objective left unclear the definition of "area." An area could be single unit (e.g., Fractions Unit 5, multiplication) or a group of units (e.g., all seven units on fractions). The corresponding Objective II in the present evaluation is not only more clearly stated but also more stringent in defining mastery. Mastery is defined in terms of both passing a posttest and also the score on the pretest; i.e., mastery gain is the variable of interest. The achievement of students who complete a unit is weighted according to their initial proficiency level.

The third problem with the original proposal's objectives was ambiguous definition of the ESAA students that would be eligible for the evaluation. If ESAA students are drawn from the ranks of the lowest achievers in each school, one would expect ESAA students, in general, to have poorer attendance and higher attrition than non-ESAA students. The inclusion of persistent truants and other non-attenders in the evaluation would provide an unfair base for assessment of the Math Component's effectiveness.

In the present evaluation, a student's "reasonable exposure" to the ESAA materials and methods is a prerequisite for that student's inclusion in the evaluation. The present evaluation design does include all ESAA students whose class attendance was 50% or more for one marking period. In short, the present evaluation design (a) includes those students whose participation would allow them to benefit from the Math Component and (b) prorates their MBSDP achievement gains based on the duration of their active participation.

## HOW DID THE MATH COMPONENT OPERATE?

This discussion includes additional description of the innovative MBSDP materials; a more detailed description of the ESAA students and their method of selection; and a description of the Component's day-to-day operation within the schools. The role of the ESAA math aide is described within the third section on daily classroom operation.

### Innovative Materials: The Curriculum of the Mathematics Basic Skills Development Project

The Mathematics Basic Skills Development Project (MBSDP) units are consumable booklets (and tests), each unit-booklet programmed to teach a specific mathematics topic; e.g., fraction concepts, division of fractions

(Fractions Unit 6), decimal concepts, multiplying decimals, metric linear measurement. Previous sections of this report (see pp. 5-6) have provided additional description of the units, the diagnostic tests, and the assignment of Mastery-Gain Points upon unit completion.

Each ESAA school was allotted MBSDP materials based on the number of ESAA students (125 copies of units for each public junior high; less for each nonpublic school).

The MBSDP units. Both Table 1 and Appendix B list all MBSDP units. Table 1, in addition, shows the percent of ESAA students in each school and in the total group who completed each unit by passing the posttest with 85% correct answers (after failing the pretest and working through the unit-booklet).

Three important points should be noted concerning the materials listed in Table 1 and Appendix B:

1. The MBSDP units varied in availability. Some units were available in a final, published version throughout the 1973-74 school year; these units have been identified in Table 1 with an asterisk (*). These published units, which were also sold outside the Minneapolis Schools, were those completed by the greatest percent of ESAA students. The four most popular units were Fraction Concepts, and Fractions Units 1, 2, and 3. Fraction Concepts was completed by over half of the ESAA students in each public school.

Another group of units was published midway through the school year. Division of Whole Numbers (traditional approach) and Adding and Subtracting Decimals are examples of those units available only during the second semester.

A third group of units (e.g., Percent 1 and 2, Area of Parallelograms and Triangles) were available only as trial versions in 1973-74.

Some students completed "old" MBSDP Units, such as Dividing and Rounding Decimals, that were early trial versions of units published or rewritten in 1973-74.

By the end of 1973-74, all of the units planned as part of the Mathematical Basic Skills Development Project were available to ESAA students in either a published or trial version.

2. Four of the widely used units--Addition of Whole Numbers, Subtraction of Whole Numbers, Multiplication of Whole Numbers, and Division of Whole Numbers--were not MBSDP units, but were instead materials originally generated by a computer program called the Arithmetic Test Generator (ATG). As part of

TABLE 1

Units of the Mathematics Basic Skills Development Project (MBSDP) Completed by ESAA Students

| MBSDP unit[a] | % of students completing each MBSDP unit | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total Group N=876 | ESAA public schools (6 junior highs, 1 high school)[b] | | | | | | | 6 Nonpublic Schools N=119 |
| | | School A N=118 | School B N=104 | School C N=130 | School D N=128 | School E N=125 | School H N=79 | School I N=73 | |
| *Addition of Whole Numbers[c] (computer-generated materials) | 13% | 0% | 16% | 4% | 22% | 44% | 1% | 0% | 8% |
| *Subtraction of Whole Numbers[c] (computer-generated materials) | 26 | 17 | 21 | 24 | 35 | 73 | 14 | 0 | 8 |
| *Multiplication of Whole Numbers[c] (computer-generated materials | 40 | 42 | 12 | 42 | 69 | 86 | 28 | 0 | 14 |
| *Division of Whole Numbers[c] (computer-generated materials | 13 | 9 | 1 | 40 | 28 | 12 | 1 | 0 | 0 |
| Division of Whole Numbers (traditional approach) | 31 | 60 | 2 | 13 | 30 | 54 | 43 | 0 | 32 |
| *Fractions Concepts | 60 | 54 | 52 | 55 | 71 | 69 | 68 | 73 | 45 |
| *Fractions Unit 1 (addition, like denominators) | 49 | 69 | 28 | 32 | 59 | 66 | 47 | 33 | 48 |
| *Fractions Unit 2 (addition, mixed numbers, like denominators) | 41 | 63 | 17 | 19 | 55 | 48 | 42 | 36 | 41 |
| *Fractions Unit 3 (subtraction, like denominators) | 48 | 69 | 11 | 30 | 77 | 47 | 46 | 58 | 39 |
| *Fractions Unit 4 (addition, subtraction, different denominators) | 37 | 61 | 4 | 22 | 59 | 31 | 34 | 52 | 35 |
| *English Measurement (linear) | 12 | 16 | 0 | 8 | 27 | 2 | 9 | 12 | 22 |
| *Fractions Unit 5 (multiplication) | 31 | 60 | 8 | 14 | 54 | 14 | 43 | 47 | 20 |
| *Fractions Unit 6 (division) | 23 | 51 | 13 | 5 | 39 | 6 | 27 | 33 | 16 |
| *Area Measurement (English) | 7 | 9 | 0 | 4 | 26 | 0 | 1 | 12 | 5 |
| *Decimal Concepts | 29 | 40 | 22 | 47 | 16 | 10 | 32 | 29 | 37 |
| Adding and Subtracting Decimals | 18 | 40 | 13 | 30 | 0 | 3 | 13 | 21 | 25 |
| Multiplying Decimals | 13 | 32 | 0 | 26 | 0 | 2 | 11 | 18 | 13 |
| Dividing and Rounding Decimals (old unit) | 7 | 9 | 0 | 10 | 0 | 0 | 6 | 29 | 8 |
| No MBSDP units completed | 8% | 1% | 22% | 6% | 0% | 0% | 5% | 8% | 22% |
| Number of different MBSDP units completed by ESAA students in school (including units listed in Footnote a) | N of different MBSDP units | | | | | | | | |
| | 32 | 24 | 14 | 26 | 23 | 19 | 24 | 17 | 24 |

Note.--An asterisk (*) denotes those MBSDP units available in a final, published version throughout the 1973-74 school year.

[a]Only those units are listed that were completed by more than 5% (47) of the total group of ESAA students. Other units and the percent of students completing them are as follows: Reading Long Numbers (1%); Metric Temperature (2); *Metric Measurement--linear (5); Division-subtractive approach (3); Liquid Measurement--English (less than 1%); Equations (1); Volume Measurement--old unit (1); *Volume Measurement--new unit (2); Metric Capacity (2); Dividing Decimals--new unit (4); Dividing and Rounding Decimals--new unit (less than 1); Percent 1 (4); Percent 2 (1); Area of Parallelograms and Triangles (2). Every MBSDP unit was used by at least 2 students.

[b]Schools F and G were omitted from this analysis because some teachers in these schools substituted other programmed, self-instruction units for certain of the MBSDP units, without clearly denoting the substitution on the student's ESAA data sheet.

[c]These whole-number units were not part of the MBSDP curriculum, but were instead worksheets and tests generated on each school's computer terminal as part of the Computer Generated Arithmetic Materials Project (see text). No MBSDP whole number units exist.

an earlier Minneapolis Schools' math project, the ATG allowed a person sitting at a school's terminal to "call" graded worksheets, answers, and achievement tests covering a particular math topic (e.g., addition of whole numbers). Since the ATG had been supplant by another computer program before 1973-74, ESAA students did not interact directly with the computer to get ATG materials. Instead, representative computer-generated ATG worksheets and tests were reprinted on masters and multiple-copied for use by ESAA students. Since no MBSDP units existed to teach addition, subtraction, and multiplication using whole numbers, the ATG worksheets and tests were the only materials used to teach ESAA students these basic whole number skills.

3. A sequence is recommended for the completion of the MBSDP units. Appendix B lists together both the mathematics units and the MBSDP measurement units. The math units are listed in the order recommended for their completion. The measurement units can be used in a more flexible order. A given measurement unit can be used at any point past the mastery of certain math prerequisites. Appendix B lists each measurement unit at the earliest point it can be taken in the MBSDP curriculum.

The cost of the MBSDP materials. In the Math Component proposal $5,105 was allotted to purchase MBSDP materials in the public schools (and approximately $500 was so allotted in the nonpublic schools). Since this proposal specified that each of nine public schools would serve 125 ESAA students, the MBSDP materials were expected to cost approximately $4.50 per student. Since slightly fewer than the expected number of students were actually served by the ESAA Math Component in 1973-74, the actual MBSDP materials cost was probably about $5.00 per student. Table 1 indicates that 806 students in seven public and six nonpublic ESAA schools were known to have completed one or more MBSDP units. Omitted from this table were 261 ESAA students in two public schools, because teachers in these schools substituted other programmed, self-instruction units for certain of the MBSDP units, without clearly indicating this substitution to the evaluator (see p. 13 below).

If one prorates the budgeted materials allotment and therefore assumes that these schools in Table 1 received approximately $4500, then the MBSDP materials cost about $5.50 for each ESAA student actually completing one or more MBSDP units. Since each of these 806 students, on the average, completed 4.7 MBSDP units (not including completions of the 4 computer-generated units), the cost of each unit completed by an ESAA student was about $1.18.

The ESAA Math Students: Their Selection and Characteristics

As discussed above, the target population for this program was junior-high-age students who in fall, 1973, were two or more years below the level of math achievement expected for their grade level. According to estimates (see Project proposal) based on 1972 citywide testing, each desegregating public junior high in 1973-74 could expect to have at least 125 students two or more years below grade level in math achievement; on the average, each school could expect more than twice that number. In the nonpublic schools, the estimated number of students two or more years below grade in math ranged from 12 to 34 per school, with a median of 22.

Final plans for the Math Component reflected a decision to serve, not the entire public-school remedial population defined above, but instead the poorest-achieving 125 math students in each public ESAA school. This decision to serve only half of the public junior-high students needing remedial math was based on three considerations: (a) the amount of ESAA funds alotted to Minnesota dictated austere program budgets; (b) the Math Component was the lowest priority ESAA Component in Minneapolis; and (c) seven of the ESAA public schools would also receive funds for remedial instruction under Title I of the Elementary and Secondary Education Act.

In the nonpublic schools, however, all students judged by their teachers to be two or more years below grade level in math were eligible for the ESAA Math Component.

A previous section (see pp. 3-4) explained that selection of individuals for ESAA math instruction was based on the September, 1973, administration of the MACT to all Minneapolis public-junior-high seventh and eighth graders. In addition, ninth graders believed to need remedial instruction in math also took the MACT at this time. The 125 lowest scorers in each ESAA junior high were supposedly designated as ESAA math students. In the nonpublic schools ESAA math students were selected without MACT testing. The fall, 1973, version of the MACT was, however, given to nonpublic ESAA math students as (a) confirmation of correct placement in the Math Component and (b) the pretest for the ESAA evaluation.

Pretest MACT performance of ESAA students. Table 2 shows the pretest (and posttest) MACT performance of ESAA students separately for each school and for the combined students in the six nonpublic schools. Table 3, instead of the school means of Table 2, presents frequency distributions for the entire ESAA group, showing the number and percent of students attaining each pretest (and posttest) percentile rank.

TABLE 2

Pretest-Posttest Performance of ESAA Students

on the Minneapolis Arithmetic Computation Test (MACT): School Means

| School | MACT performance of ESAA students[a] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pretest (September, 1973) | | | Posttest (May, 1974) | | | Gain (posttest minus pretest) | | | |
| | N taking test | Mean percentile rank | Standard deviation | N taking test | Mean percentile rank | Standard deviation | N taking both tests | Mean gain in rank | Standard deviation | % who had same or higher posttest rank[c] |
| A | 118 | 12 | 6 | 95 | 18 | 14 | 95 | 6 | 14 | 62% |
| B | 103 | 10 | 7 | 95 | 12 | 10 | 95 | 2 | 9 | 66% |
| C | 128 | 20 | 12 | 110 | 18 | 16 | 110 | -2 | 15 | 38% |
| D | 125 | 17 | 10 | 105 | 32 | 19 | 102 | 14 | 19 | 75% |
| E | 123 | 19 | 10 | 120 | 26 | 16 | 118 | 7 | 15 | 69% |
| F | 112 | 11 | 8 | 87 | 24 | 19 | 87 | 13 | 16 | 84% |
| G | 110 | 19 | 14 | 112 | 20 | 15 | 89 | 1 | 14 | 53% |
| H | 79 | 18 | 9 | 68 | 25 | 19 | 68 | 6 | 19 | 56% |
| I | 66 | 27 | 17 | 23 | 26 | 14 | 21 | -4 | 11 | 43% |
| 6 Nonpublic schools | 110 | 17 | 14 | 109 | 23 | 17 | 102 | 7 | 17 | 70% |
| Total group of "pure ESAA" students[b] | 852 | 17 | 12 | 725 | 22 | 17 | 711 | 5 | 16 | 62% |

[a]The Minneapolis Schools' Mathematics Department computed separate percentile norms for each grade level (7th and 8th) and for each test administration (September and May). In constructing the present table, each ESAA student's raw score was referred to the appropriate percentile norms. Raw scores of 9th grade ESAA students were referred to 8th grade norms (since no citywide 9th grade norms exist).

[b]ESAA students from Schools F and G were omitted from this total group of "pure ESAA" students. Some of these ESAA-eligible students in Schools F and G had not used MBSDP materials, although by special arrangement with the evaluator, these students' progress on non-MBSDP programmed materials was translated into Mastery Gain Points. Nevertheless, because the original Math Component plan was not followed, students in Schools F and G were not included in the total group of "pure ESAA" students (using only MBSDP units for programmed learning of math basic skills).

[c]One objective of the Math Component specified that 50% of the students would have the same or higher percentile rank in the spring, compared to the fall-pretest rank. Note that 7 of 9 public schools, the combined parochial schools, and the total "pure ESAA" group met this objective.

For a total group of 852 ESAA students, the mean of the pretest percentile ranks was 17.1, based on all Minneapolis seventh and eighth graders taking the same September, 1973, test. Table 3 indicates that 86% of the ESAA students had a citywide percentile rank below 30 on the pretest.

Among ESAA schools, the highest mean percentile rank on the pretest was 27, obtained by School I's students (see Table 2). The students in School I were all ninth graders, accounting for their relatively high position among the total group of ESAA students. (Since ninth graders do not ordinarily take the MACT, the MACT scores of ESAA ninth graders were therefore referred to eighth grade norms.)

Although the Project proposal did not specify upper limits on MACT scores for students' Math Component participation, one might question the selection for the program of those 7% of ESAA students who scored at or above the thirty-fifth percentile on the pretest. It seems unlikely that these students were either the lowest achieving math students in their schools, or two or more years below grade level in math achievement.

Students omitted from analyses involving the "total group" of ESAA students. Footnotes to Tables 1, 2, 3, and 5 indicate that ESAA students in Schools F and G were omitted from data analyses involving the total group of "pure ESAA" students. The 876 students whose progress is charted in Table 1, for example, and the 852 students constituting the "Total" pretest group in Table 2, are called "pure ESAA" because they used only MBSDP materials (and the four units of computer-generated arithmetic materials listed in Table 1). In ESAA Schools F and G some teachers substituted other programmed, self-instruction units (e.g., on whole number division and fractions) for a number of the MBSDP and computer-generated units listed in Table 1. Teachers in Schools F and G, by special arrangement with the evaluator, translated students' progress on non-MBSDP programmed materials into the Mastery Gain Points described earlier. Nevertheless, because the original Math Component plan was not followed, and because teachers in Schools F and G did not clearly distinguish students who used only MBSDP units from those who did not--all 261 ESAA-eligible students in Schools F and G were omitted from data analyses involving "pure ESAA" students (those who used only MBSDP materials for the programmed learning of math basic skills.)

In summary, the original plan for the Math Component was not followed in Schools F and G. Nevertheless, the mastery gains and characteristics of

TABLE 3

Pretest-Posttest Performance of All ESAA Students on the Minneapolis Arithmetic Computation Test (MACT): Frequency Distribution

| Percentile rank (among all Minneapolis Public School students taking test)[a] | Pretest (September, 1973) N=852 students taking test | | Posttest (May, 1974) N=725 students taking test | |
|---|---|---|---|---|
| | N of ESAA students attaining this rank | % of ESAA students attaining this rank | N of ESAA students attaining this rank | % of ESAA students attaining this rank |
| 75-99 | 1 | 0 | 9 | 1 |
| 70-74 | 1 | 0 | 2 | 0 |
| 65-69 | 1 | 0 | 4 | 1 |
| 60-64 | 1 | 0 | 5 | 1 |
| 55-59 | 5 | 1 | 13 | 2 |
| 50-54 | 2 | 0 | 35 | 5 |
| 45-49 | 7 | 1 | 21 | 3 |
| 40-44 | 18 | 2 | 27 | 4 |
| 35-39 | 22 | 3 | 46 | 6 |
| 30-34 | 57 | 7 | 52 | 7 |
| 25-29 | 107 | 12 | 48 | 7 |
| 20-24 | 114 | 13 | 99 | 14 |
| 15-19 | 120 | 14 | 68 | 9 |
| 10-14 | 171 | 20 | 99 | 14 |
| 5-9 | 124 | 15 | 93 | 13 |
| 0-4 | 105 | 12 | 104 | 14 |

Descriptive statistics

| | | |
|---|---|---|
| Mean Percentile rank | 17.1 | 22.4 |
| Standard deviation of percentile ranks | 11.6 | 17.1 |
| Mean gain in percentile rank[b] | 5.5 | |
| Standard deviation of mean gain[b] | 16.1 | |

Note.--ESAA-eligible students from 2 of the 9 public schools (146 students in one school, 115 in the other) were omitted from this analysis. Some of these students had not used MBSDP materials and were therefore not participants in the ESAA Math Program. (Some used other programmed materials.) In these two schools, ESAA students (using MBSDP materials) were not clearly differentiated from non-ESAA students.

[a]The Minneapolis Schools' Mathematics Department computed separate percentile norms for each grade level (7th and 8th) and for each test administration (September and May). In constructing the present table, each ESAA student's raw score was referred to the appropriate percentile norms. Raw scores of 9th grade ESAA students were referred to 8th grade norms (since no citywide 9th grade norms exist).

[b]Gain in percentile rank was calculated for the 711 students taking both pretest and posttest. Of these students, 410 or 58% had a higher percentile rank in the spring than in the fall; 29 (4%) had the same rank; and 272 (38%) had a lower rank. One objective of the Math Component specified that 50% of the ESAA students would have the same or higher rank in the spring. Since 62% of ESAA students maintained or improved their relative position among their peers, this objective was met.

ESAA students in Schools F and G are reported in Tables 2, 4, and 5. Students in these two schools were, however, omitted from data analyses involving the total group of pure ESAA students and showing their success in meeting Component objectives.

Number of students served by the Math Component. Table 4 indicates that 1200 students were served by the ESAA Math Component. The entries in various tables of the evaluation report, however, are based on fewer than 1200 students for the following reasons: (a) a number of ESAA students did not take the MACT pretest, the posttest, or both; Table 2 shows that only 887 ESAA students (711 "pure ESAA" students plus ESAA students in Schools F and G) took both pretest and posttest. (b) For 53 students participating in the Math Component (usually for short periods), neither MBSDP nor MACT data were available. (c) For a remaining 10 or so known ESAA students, MACT scores were available, but the evaluator could not determine whether or not MBSDP units had been completed.

In the ESAA public schools, the mean number of students served was 120 per school, a figure which approximates the planned average of 125 per school. Two schools, H and I, were markedly below expectation in the number of students served. In the 6 nonpublic schools, the mean number of students served was 20 per school.

Student demographic characteristics. In most schools, and for the ESAA students as a total group, boys outnumbered girls (Table 4 shows 57% vs. 43% for the total group).

Approximately half the students were seventh graders. The distribution of students by grade level varied greatly from school to school. This variation was in part due to two schools having no seventh grade in 1973-74 and two having no ninth grade. One of the ESAA schools was a high school, and the ESAA students therefore only represented the ninth grade. In Schools B, C, and E, however, there is no ready explanation for the lack of ninth grade participation in the ESAA Math Component, since all three schools had a ninth grade. Similarly, School D had an eighth grade, but no eighth-grade ESAA students. Apparently, since a teachers' participation in the ESAA Math Component was voluntary, the remedial-math teachers of the omitted grade levels in Schools B, C, D, and E decided not to use the MBSDP math aides and MBSDP materials.

Table 4 also indicates that for the total student group over half (56%) were White Americans, about one-third (36%) were Black Americans, and less

Table 4

Selected Characteristics of ESAA Math Students

| School | Student characteristic | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Students with data on math achievement[a] | Grade placement during 1973–74 | | | Sex | | Race or ethnic group[b] | | | Did student ride bus to achieve desegregation? | |
| | N | 7th % | 8th % | 9th % | Boy % | Girl % | White American % | Black American % | Indian American % | Yes % | No % |
| A | 119 | 53% | 47% | 0% | 55% | 45% | 48% | 51% | 1% | 11% | 89% |
| B | 105 | 59 | 41 | 0 | 68 | 32 | 69 | 26 | 4 | 36 | 64 |
| C | 131 | 75 | 25 | 0 | 58 | 42 | 62 | 6 | 32 | 30 | 70 |
| D | 129 | 0 | 0 | 100 | 62 | 38 | 47 | 52 | 0 | 71 | 29 |
| E | 126 | 91 | 9 | 0 | 56 | 44 | 62 | 37 | 0 | 91 | 9 |
| F | 115 | 60 | 40 | 0 | 61 | 39 | 61 | 30 | 8 | 35 | 65 |
| G | 146 | 46 | 52 | 2 | 66 | 34 | 66 | 25 | 6 | 46 | 54 |
| H | 80 | 0 | 68 | 32 | 45 | 55 | 4 | 96 | 0 | 0 | 100 |
| I | 75 | 0 | 0 | 100 | 38 | 62 | 40 | 56 | 4 | 0 | 100 |
| 6 Nonpublic schools | 121 | 56 | 36 | 8 | 51 | 49 | 73 | 12 | 12 | —[c] | —[c] |
| Total group | 1147 | 47% | 32% | 21% | 57% | 43% | 56% | 36% | 7% | 35%[d] | 55%[d] |

[a]These totals include all students with data on (a) Mastery-Gain Points earned on MBSDP units and/or (b) MACT scores. For an additional 53 students participating in the Math Component (usually for short periods), no such math achievement data were available.

[b]An additional 10 students were Spanish-surnamed, and 6 were designated "Other" race or ethnic group. Information on racial/ethnic group was missing for 66 students.

[c]The desegregation plan, with busing, applied only to public schools (although ESAA nonpublic schools were all required to demonstrate their lack of racial discrimination in admissions and hiring).

[d]Based on public-school students only.

than one in ten (7%) were Indian Americans. Spanish-surnamed students, and students designated "Other" race or ethnic group constituted only 1% of the ESAA group.

For grades 7-9 in the city of Minneapolis as a whole, 83% of the students during 1973-74 were White, 12% were Black, 4% were Indian, 1% were Spanish-surnamed, and 1% represented other racial categories. (Information on racial/ethnic composition was obtained from the Pupil Personnel Sight Count 1973-74, prepared by the Minneapolis Public Schools' Planning and Support Services Division, 1973.)

For the junior-high grades in just the ESAA public schools, the relative frequencies of the various minority groups were generally higher than the citywide relative frequencies for the same grades. In ESAA schools in 1973-74, 73% of the junior-high-level students were white, 19% were Black, 6% were Indian, 1% were Spanish-surnamed, and less than 1% represented other minorities.

In every ESAA public school except B and C, the percentage of minority students was higher for the Math Component than for grades 7-9 in the total student body. The percentage of minority students (Black, Indian, Spanish-surnamed, and Asian American) in grades 7-9 in each ESAA school ranged from 8% to 40% (with the exception of one junior high having a minority enrollment of 82%; this school was closed as a junior high at the end of the 1973-74 school year). The median minority enrollment among these schools was approximately one-third. The ESAA math programs in four schools (A, D, H, and I) exceeded 50% minority students, however. In School D, 52% of the ESAA math students represented minorities, more than doubling the 23% minority enrollment of the school as a whole. In School E the ESAA minority enrollment of 37% was over four-and-one-half times the school's 8% minority enrollment.

Table 4 shows that in Schools D and E a great majority (71% and 91%, respectively) of the ESAA students rode the bus as part of the Minneapolis Schools' desegregation plan. For other ESAA public schools, the proportion of ESAA math students riding the bus was always less than half. For all ESAA public-school math students taken together, the proportion of bus riders was about one-third.

The Staffing and Daily Operation of the Math Component

Staffing. Each of the ESAA public junior highs received the equivalent of two full-time math aides, and nearly all nonpublic schools received one part-time math aide. Only St. Joan of Arc received no math aide (although the Math Component did provide MBSDP materials to this nonpublic school). The following public schools had two full-time aides: Anthony, Jefferson, Jordan, and Phillips. Lincoln and North each had one aide. Bryant and Franklin each

had three part-time aides; Ramsey had four part-time aides. A total of 25 individuals served as aides in the Math Component, although some of these aides worked part-time.

The Math Component funded the equivalent of 16 full-time (seven hours per day) math aides for public junior highs. In nonpublic schools the equivalent of four full-time aides was funded. The money for nonpublic-school aides, however, had to be used to hire not only math aides, but also aides for the ESAA Reading Component. One nonpublic-school aide, in fact, served both the Math and Reading Components.

The Math Component also funded a 0.6-time Math Coordinator to serve as a resource to all ESAA schools (see p. 1).

As stated previously, the Math Component did not fund any classroom teachers. The ESAA math aides worked under the supervision of existing classroom teachers. A total of 44 teachers in both public and nonpublic schools used ESAA math aides and MBSDP materials during 1973-74.

Apparently, the participation of classroom teachers in the Math Component was voluntary in most schools. The number of math teachers using aides and materials ranged from two to five in the public schools. One or two teachers in each nonpublic school participated. The following public schools had 5 participating teachers: Schools B, E, F, and G. Schools A and C had four teachers. Schools D and I had three teachers. School H had two.

Appendix C is a questionnaire on the ESAA Math Component completed by 43 of the 44 participating teachers. Appendix D is a questionnaire on the role of the ESAA math aide, which was completed by 24 of the 25 math aides. The responses of the teachers and aides have been tabulated on these sample questionnaires.

Appendices C and D show that most of the staff persons employed in the Math Component were White American (91% of the 43 responding teachers, 71% of the 24 responding aides). Teachers tended to be male (60%) and aides tended strongly to be female (92%). All of the minority aides and teachers were Black American.

Daily operation. The ESAA Math Component depended for its implementation on the voluntary acceptance of math aides and MBSDP materials by participating teachers of remedial math. The part-time ESAA Math Coordinator provided consultation, not supervision, for the teachers and aides. Math classes aided by ESAA varied from school to school in (a) student composition, (b) the use of MBSDP materials, and (c) the role assigned by teachers to the ESAA math aides.

In most of the ESAA schools, the officially designated ESAA students and

non-ESAA students worked side-by-side in the same remedial math classes. ESAA math aides for these classes served both ESAA and non-ESAA students. In some schools aided by Title I, both ESAA math aides and Title I math aides served the same students. Only in School D were "pure" ESAA math classes constructed from the master list of ESAA students. School E, in contrast, had no ability grouping, and ESAA students were enrolled in the same math classes with students of higher achievement levels.

The use of MBSDP materials and the emphasis placed on these materials varied widely from school to school, and even within the same school. While over 9 of every 10 teachers and over 9 of 10 ESAA aides rated the MBSDP materials as having at least "Moderate interest" for ESAA students (see Appendices C and D), nevertheless nearly all of the teachers used other commercial materials in teaching the areas covered by the MBSDP curriculum. While most teachers and aides praised the interest level and instructional value of the MBSDP units, their written comments suggested that student interest waned with overreliance on any single teaching approach or math curriculum. Other basic skills materials used by ESAA students included computer-generated materials (other than the whole number units listed in Table 1), textbooks, puzzles, and wooden bars to teach fractions concepts.

In one ESAA school a participating teacher, as part of a Title I project, developed units of materials covering many of the same areas as the MBSDP. This teacher and others in the same school were understandably reluctant to replace their own indigenous units with those of the MBSDP.

Problems in the availability of MBSDP materials. Questionnaire comments by a number of participating teachers suggested that supplies of MBSDP materials were insufficient to serve their remedial students. A few teachers, of course, wanted materials to serve more than the 125 officially designated ESAA students. In a few schools, however, the 125 or so ESAA students were inadequately supplied. Six teachers complained of delays in filling their MBSDP orders. Others were disappointed by lags in the publication of needed units (e.g., decimals). Some teachers resorted to machine duplication of units in short supply. Part of the responsibility for materials shortages probably rests with those teachers who failed to place timely orders with the ESAA administration.

The enacted role of the math aides. Teachers participating in the Math Component deployed aides in one of two ways. Some (e.g., in Schools E, F, and G) sent students individually or in small groups to work with aides

in separate offices outside the classroom. Teachers in other schools (e.g., D, H, and I) generally worked side-by-side with aides in the classroom. Among a small sample of aides personally questioned by the evaluator, all preferred to work within the classroom.

The following description of the math aides' work in the schools is based on the aides' responses to the questionnaire concerning their enacted role (see Appendix D). For each of 10 activities, aides were asked (a) whether they performed the activity; (b) how they performed the activity (including any "tips" they would suggest to others wanting to help ESAA students master mathematics); and (c) the percent of total time they spent on the activity. The following picture of the math aide's role emerged.

Approximately 60% of the aides' time was spent in four activities which involved direct interaction with students. The aides' single most time-consuming activity was "helping individual students to do their work," which occupied 25 minutes of every classroom hour, on the average. Similar activities included "helping small groups of students to do their work" (8 minutes per hour, on the average) and "giving feedback to students concerning their classroom performance" (2 minutes). Commenting on these activities, seven aides felt that ESAA students thrive on patience, encouragement, and individual attention. According to four aides, giving positive feedback is an important part of the aide's job ("even when I'm busy," said one aide). A few aides found time to "rap" with students about personal problems or just to get acquainted with students.

Various clerical tasks, including record-keeping, occupied approximately 40% of the aides' time. These activities included (a) scoring tests and other written materials (6 minutes of every hour, on the average); (b) maintaining student records concerning MBSDP progress, MACT scores, grades, and attendance (4 minutes); (c) passing out and monitoring tests (2 minutes); (d) selecting, finding, or writing materials to supplement the MBSDP materials (2 minutes); and (e) duplicating tests, MBSDP units, and other written materials.

Other infrequent activities included participation in parent-teacher conferences, typing, housekeeping, and assisting the teacher with grading. One aide inappropriately spent some time helping students who forgot their lock combinations.

Apparently, the math aides generally enjoyed good working relationships with their supervising teachers. Approximately half of the aides and half of the teachers rated the aide-teacher relationship as "Excellent." Only

two teachers (and no aides) rated the relationship, "Poor." (See the six-point scale in Appendices C and D).

In School G, notable exceptions occurred to this pattern of generally good working relationships. The ESAA aides in School G were located in an office outside the classrooms. The teachers, however, sent very few students to these aides. One teacher tended to send students who were disruptive rather than remedial. The two aides formally approached each teacher of ESAA students, after making a master list of each ESAA student's math teacher, class time, and room location. The aides offered to take ESAA students for tutoring and work on MBSDP materials. Little increase in referrals occurred, however, leading one aide to say, "I sometimes feel some teachers don't really support the concept of this program."

## THE EFFECTIVENESS OF THE MATH COMPONENT IN MEETING ITS OBJECTIVES

The Math Component not only met, but surpassed, its two goals for gains in mathematics mastery among the lowest-achieving, junior-high math students in Minneapolis schools.

The first part of this section concerns the attainment of the two main program objectives. The second part discusses some differences among the ESAA math programs in the ESAA public schools plausibly accounting for the observed differences in their math-skill gain rates.

Objective I. Tables 2 and 3 show that 62% of the evaluation-eligible ESAA students who took both the fall and spring MACT had a percentile rank in May, 1974, which was the same as, or higher than, their percentile rank in September, 1973. Objective I was therefore met, since it required only 50% of ESAA students to maintain or improve their relative position among their peers.

Objective I was not only met among the total group of "pure ESAA" students, but also within seven of nine public schools and the combined six nonpublic schools. The median school gain (counting the nonpublic group as one "school") was 5.5. These school means ranged from -4 percentile points of "gain" (for School I) to 14 points (for School D).

Objective II. Attainment of Objective II required that 50% of the evaluation-eligible ESAA students earn Mastery-Gain Points on MBSDP units at the rate of 40 or more per year (10 or more points per quarter). Table 5 shows that in fact two-thirds of the total group of "pure ESAA" students met this objective.

TABLE 9

Mastery-Gain Points Earned by ESAA Students
on Units of the Mathematics Basic Skills Development Project (MBSDP)

| Mastery-Gain Points earned per quarter[a] | % of students attaining each quarterly rate of Mastery-Gain Points earned | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total group of "pure ESAA" students[b] N=876 | ESAA public schools (8 junior highs, 1 high school) | | | | | | | | | 6 Nonpublic schools N=119 |
| | | School A N=118 | School B N=104 | School C N=130 | School D N=128 | School E N=125 | School F N=115 | School G N=146 | School H N=79 | School I N=73 | |
| 40 or more | 6% | 9% | 0% | 3% | 8% | 2% | 11% | 7% | 0% | 25% | 5% |
| 35-39 | 4 | 13 | 0 | 3 | 5 | 0 | 4 | 3 | 0 | 7 | 2 |
| 30-34 | 5 | 12 | 1 | 5 | 9 | 2 | 9 | 6 | 5 | 4 | 1 |
| 25-29 | 10 | 18 | 1 | 7 | 16 | 12 | 12 | 6 | 8 | 6 | 5 |
| 20-24 | 13 | 20 | 4 | 10 | 18 | 13 | 16 | 8 | 16 | 11 | 10 |
| 15-19 | 15 | 10 | 2 | 20 | 19 | 17 | 13 | 10 | 22 | 6 | 19 |
| 10-14 | 15 | 12 | 9 | 18 | 14 | 24 | 22 | 16 | 12 | 16 | 12 |
| 5-9 | 19 | 3 | 39 | 18 | 7 | 25 | 11 | 26 | 29 | 14 | 22 |
| 1-4 | 7 | 3 | 23 | 10 | 4 | 5 | 3 | 10 | 3 | 3 | 2 |
| 0 | 8 | 1 | 22 | 6 | 0 | 0 | 0 | 10 | 5 | 8 | 22 |
| Descriptive statistics | | | | | | | | | | | |
| Mean quarterly rate of Gain Points earned | 17.2 | 24.9 | 6.0 | 14.8 | 22.1 | 15.8 | 22.1 | 15.1 | 14.5 | 26.9 | 13.9 |
| Standard deviation of quarterly rate | 13.7 | 11.2 | 6.0 | 10.6 | 10.7 | 9.8 | 12.9 | 14.1 | 8.1 | 23.6 | 15.4 |
| % of students with rates of 10 or more points per quarter (40 or more points per year) | 67% | 92% | 16% | 66% | 89% | 70% | 87% | 54% | 63% | 75% | 54% |

Note.--Each student, after successfully completing an MBSDP unit (answering 85% correct on a posttest), was awarded "Mastery-Gain Points." As shown in Appendix A and as explained in the text, the number of Gain Points earned depended on both (a) the "estimated difficulty" of the unit, and (b) the student's score on the unit pretest. For each student, a Mastery-Gain-Point total was computed for all units successfully completed.

[a] For each student, this quarterly rate of Gain Points earned was obtained by dividing (a) the Mastery-Gain-Point total by (b) the total number of quarters that the student attended half (50%) or more of the ESAA math-class sessions held. For one school on a trimester grading system, each student's trimesterly rate was prorated and expressed as a quarterly rate.

[b] ESAA students from Schools F and G were omitted from this total group of "pure ESAA" students. Some of these ESAA-eligible students in Schools F and G had not used MBSDP materials, although by special arrangement with the evaluator, these students' progress on non-MBSDP programmed materials was translated into Mastery Gain Points. Nevertheless, because the original Math Component plan was not followed, students in Schools F and G were not included in the total group of "pure ESAA" students (using only MBSDP units for programmed learning of math basic skills).

[c] One objective of the Math Component specified in part that 50% of the ESAA students would earn Mastery-Gain Points at the rate of 40 or more per year. Note that 8 of 9 public schools, the combined nonpublic schools, and the total "pure ESAA" group met this objective.

As with Objective I, the great majority of individual ESAA schools, as well as the total student group, met Objective II. In eight of nine public schools (including "non-pure" Schools F and G) and in the combined nonpublic schools, ESAA students earned Mastery-Gain Points at the rate of 10 or more Points per quarter. The median school gain was 15.4 Points per quarter. The range of school means was from 6.0 Points per quarter (for School B) to 26.9 Points (School I).

Table 5 also shows that in every school except B, half or more of the ESAA students met Objective II. Schools with the highest percent of ESAA students meeting Objective II were A, D, and F, where approximately 9 of every 10 students earned 10 or more points per quarter. School B had the lowest percent (16%) of students meeting Objective II, a rate less than one-fourth that of any other ESAA public school.

The Ambiguous Meaning of MACT Gains

Objective I, pertaining to MACT gains, was clearly met. As specified in the formal statement of the objective, 62% of "pure ESAA" students maintained or improved their relative MACT standing among their Minneapolis grade-level peers. Table 3 shows a mean gain in percentile rank of 5.5 for those 711 "pure ESAA" students taking both the pretest and posttest.

Because of the method used to select ESAA students, however--that of choosing for the Math Component the lowest-scoring students on the fall MACT--one cannot determine whether this mean gain of 5.5 percentile points represents a real improvement in these students' relative standing in math basic skills or an artifactual gain attributable to pretest-to-posttest regression.

Whenever a group is selected for the extremity of its scores on a test, then the same group would be expected to have less extreme scores, on the average, on a second equivalent test, even if no educational treatment intervened between the two tests. This "regression artifact," described by a number of statisticians including Campbell and Stanley (1963, pp. 10-12), is possible for all tests that have an imperfect (less than 1.0) test-retest correlation. This statistical phenomenon is expected whenever groups are

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[2] A pretest and posttest are imperfectly correlated whenever a student's posttest score is not completely predictable from that student's pretest score. Students with the same pretest score may obtain different posttest scores for many reasons. For example, students may learn different amounts, or, on a particular day and a particular test, they may show differences in effort, experience differences in fatigue, or have differences in "luck." All of these factors except actual learning contribute to both error of measurement and an imperfect test-retest correlation.

chosen because they lie at the extremes of a score distribution (i.e., they have extremely low scores or extremely high scores).

In the case of MACT scores, one might imagine choosing two groups: students with extremely low MACT scores (e.g., ESAA students) and students with extremely high scores. Even if no Math Component were administered and no real change in math ability occurred, one would expect that on any post-test MACT (e.g., after a short period), the extremely low pretest scorers would generally make higher raw scores and percentiles, and the extremely high pretest scorers would, on the average, have poorer posttest scores and percentiles. Except for the knowledge that no instructional program took place (in this fictitious example), one might erroneously conclude that the poorest students were getting better and the best students were getting poorer.

In short, the finding that ESAA students in general improved their MACT percentile rank from fall to spring is not surprising. Nor is the degree of gain a firm estimate of the degree to which ESAA students in 1973-74 improved their "true" math skills relative to their same-grade peers.

The size of the percentile gain attributable to the regression artifact will be roughly estimated in the following discussion:

According to the frequency distributions of 1973-74 MACT scores (Appendix A), the mean September raw score for all Minneapolis seventh graders was 12.9; for all eighth graders, the mean pretest raw score was 17.3. For all "pure ESAA" students the mean pretest raw score was 6.5.

Although information on the psychometric characteristics of the MACT is not available, let one assume that any two forms of the MACT have equal means, equal variances, normal distributions of scores, and test-retest correlations in the respectable neighborhood of .80. Then the posttest MACT scores of ESAA students (selected only on the basis of a low pretest score) should, on the average, be 20% closer to the mean than the same students' pretest scores, even if no schooling intervened between pretest and posttest. This statistical regression of 20% toward the mean follows directly from the assumption that the test-retest correlation is .80.

Schooling did, of course, intervene between fall and spring administrations of the MACT. Minneapolis seventh graders, on the average, had 6.7 more correct answers on the posttest than on the pretest. Remedial seventh graders who scored near the ESAA mean of 6.5 points on the pretest, however, needed to get only about 5 more problems correct on the posttest to maintain their percentile rank among all seventh graders of about 23.

Minneapolis eighth graders, on the average, improved their pretest MACT performance by 4.7 raw-score points. Remedial students with pretest

answering near 6.5 on the pretest needed between 4 and 5 additional correct answers to maintain their percentile rank among all eighth graders of about 12.

The average ESAA student answered slightly over 6 more problems correct on the posttest than on the pretest. The question is, How much of this 6.2 point gain is attributable to regression and how much is due to real gain in math skills?

If both ESAA seventh graders and ESAA eighth graders had the same average pretest raw score of 6.5, then ESAA seventh graders were 6.4 points below the Minneapolis seventh grade mean, and ESAA eighth graders were 10.8 points below the Minneapolis eighth grade mean. One could therefore estimate that the pretest-to-posttest gain due to regression is about 1 raw-score points for seventh graders and about 2 points for eighth graders.

Subtracting the estimated gain due to regression, the corrected mean raw gain for ESAA seventh graders was approximately 5 correct answers and the corrected mean gain for ESAA eighth graders was about 4 points.

Although the Math Component met Objective I as stated in the proposal, with 62% of ESAA students maintaining or improving their relative standing on the MACT, the above discussion suggests that the "true" gains in mastery of MACT-type math problems were probably the same for ESAA students and for other remedial math students in Minneapolis having the same fall, 1973, grade placement and pretest scores. If the above reasoning is correct, probably about 50% of the total group of "pure ESAA" students, not 62%, actually improved their standing among peers in skills measured by the MACT.

Differences Among Schools in the Math Gains of Their ESAA Students

As discussed above, every school surpassed at least one of the mastery-gain rates specified by the two program objectives; most schools exceeded both objectives. Since differences in mastery gain did emerge among the schools, however, this section of the report explores some factors plausibly accounting for a school's greater or lesser success in meeting program objectives.

The relationship between mastery gains as measured by the MACT and gains measured by progress on MBSDP units. First, for individual students it appears that progress on MBSDP units was only moderately related to MACT gain. For those 711 pure ESAA students with complete data, the correlation between total Mastery-Gain Points earned and raw MACT gain was .30, accounting for less than 10% of the variance in either set of scores. This modest correlation between MBSDP progress and MACT gain is not surprising, and indicates that students' completion of MBSDP units is neither a necessary nor sufficient condition for MACT gain.

For schools, however, the correlation between MBSDP progress and MACT gain was greater than the corresponding correlation for individual students. When the performance of all ESAA students at a given pure-ESAA school (except I)[3] was combined, the mean number of MBSDP points earned correlated .56 with that school's mean MACT gain. Since this correlation is based on only 6 pairs of means, it is not reliably different from zero at the 5% significance level. If this correlation proves stable, it would indicate that a student's substantial progress on MBSDP units is most predictive of high MACT gains in schools where that student's ESAA peers also earn a relatively high number of MBSDP points.

Higher-gain and lower-gain schools. The school means on MBSDP progress and MACT gain were studied to select ESAA schools more and less successful in meeting Math Component objectives. Schools D, E, and F were above the median of all ESAA public schools in both MBSDP progress and MACT gain; these three schools are called "higher-gain schools." Schools B, C, and G fell below the median on both indices of mastery gain and are called "lower-gain schools." The terms "higher-gain" and "lower-gain" do not, of course, imply absolute judgments and are relative only to differences between the public schools involved in the ESAA Math Component.

Characteristics of higher-gain and lower-gain schools. Differences between the Math Components in the higher-gain and lower-gain schools were sought, to plausibly account for their differences in math-mastery gain. A number of potentially relevant differences were explored and discarded as important correlates of mastery differences between these schools. The school's mean pretest MACT score, the percent of boys vs. girls in the ESAA Math Component, and the number of students served were among the variables that failed to differentiate higher-from lower-gain schools. The following differences between higher-and lower-gain schools, seemingly relevant to mastery gain, were noted:

1. In the higher-gain schools, the teachers and aides in the ESAA math program seemed better organized than the ESAA teachers and aides in the lower-gain schools. In School D a strong leader emerged among the three participating ESAA math teachers. This teacher coordinated the scheduling of remedial math classes, the work of the ESAA math aides, and the ordering of MBSDP materials. Each participating teacher taught two classes consisting entirely of ninth-grade ESAA students. The teachers and aides all used the same large room for lesson planning, clerical work, and discussion of common instructional problems.

[3]School I was omitted because the MACT gain mean was based on only 21 of the 75 students participating in the program.

The fact that ESAA students in School D were all ninth graders cannot solely account for the high gains of these students; in School E, for example, 9 of every 10 students were seventh graders, and yet School E was also a higher-gain school. In School E, as in School D, the teachers of ESAA students and the aides also shared a common preparation room. The evaluator's observations suggested that ESAA math teachers in the higher-gain schools communicated with each other more frequently than teachers in the lower-gain schools: such discussion probably made possible mutual help in the difficult task of teaching remedial students.

2. The ESAA teachers in the higher-gain schools seemed to have more genuine enthusiasm for the teaching of remedial math than teachers in the lower-gain schools. In School D, for example, the teacher who emerged as the unofficial leader of the ESAA program was eager for the evaluator to observe her ESAA classes. School F had actively sought funds and staff to improve its remedial programs. One teacher in School F was a specialist in remedial math who had developed his own basic skills materials as part of a Title I project.

3. Teachers in the higher-gain schools were more favorable toward MBSDP materials than teachers in the lower-gain schools. The teachers in higher gain schools generally rated the MBSDP materials as having "High interest" for ESAA students, while teachers in lower-gain schools rated the materials slightly lower, as having between "Moderate" and "High" interest (see question in Appendix C).

In their responses to the ESAA teacher questionnaire, 3 of the 13 teachers in higher-gain schools spontaneously expressed a desire for more MBSDP materials, so they could serve more than 125 remedial students in their schools. None of the teachers in lower-gain schools expressed such a desire.

4. The ESAA math aides were used more efficiently, and granted more responsibility, in the higher-gain schools than in the lower-gain schools. In Schools D and F the aides were respected by teachers as valued colleagues in the classroom. For example, the "lead" teacher in School D introduced each aide to the evaluator as an important member of the instructional team. In School D aides worked side-by-side with teachers, and aide morale seemed extremely high. In School F the ESAA math teachers also showed considerable respect for aides, sending students in small groups to the aides for remediation of specific weaknesses.

In lower-gain School G, as described above, the aides were relatively isolated from both teachers and students. Aide morale was low when

the evaluator visited School G in May 1974. One teacher in School G volunteered the judgment that ESAA math aides had not been used effectively.

## RECOMMENDATIONS

Recommendations regarding the improvement and re-funding of this program may be academic, since the decision has already been made to discontinue funding for the ESAA Math Component. The evaluator nevertheless offers the following suggestions, in the hope that they will be useful to those who plan and seek funding for future programs of this type.

Recommendations for the Improvement of Math Component Operation

1. A more efficient system of ordering and delivering materials should be instituted. Several teachers and aides complained of inadequate supplies of MBSDP materials and delays in receiving ordered materials. Sufficient quantities of all MBSDP units (one copy of the most commonly used units for each ESAA student in each school; fewer copies of less frequently used or "optional" units) should be ordered by the ESAA administration before the start of the school year. These materials should then be stored in a central ESAA math-materials depository. A memo from an ESAA math teacher to the ESAA Math Coordinator should be sufficient to release the needed materials to the school. The materials, already allotted to the school and in storage, could arrive in the classroom within one or two days of the order.

2. As a prerequisite for a school's participation in the Math Component, a group of remedial math teachers in the school should formally commit themselves to the use of ESAA math aides, the use of MBSDP materials, and the scheduling of regular meetings of ESAA math aides and teachers during the school year. Since the Math Component funds no teachers, and since aides do not have authority for instruction within the school, some organization of ESAA staff within the school seems necessary to insure that the Math Component will be carried out according to basic plan.

3. A full-time ESAA Math Coordinator is needed to supervise the delivery of MBSDP materials (Recommendation 1) and the maintenance of adequate Math-Component organization within each school (Recommendation 2).

4. The ESAA Project Staff should carefully consider the fact that students of racial minorities were overrepresented in the ESAA math programs of some schools (see pp. 15-17). Educational need should be synthesized with the need for racial balance so that unintended resegregation does not occur.

5. The participating teachers should more carefully screen incoming ESAA students to insure that students selected are those for whom the Math Component is intended. Although the great majority of 1973-74 ESAA students were well suited to the program, 7% of the students were above the thirty-fifth percentile on the MACT pretest. Such students do not seem markedly below their peers in math achievement.

6. As in the past, minority persons should be encouraged to apply for positions as math aides. Some slight improvement in recruitment of racial minorities seems warranted. Among ESAA students, 38% were Black American and 7% were Indian American. Among ESAA math aides, 25% were Black American and none were Indian American.

7. The specification of Math Component objectives in terms of MACT gain scores is inappropriate and misleading, in view of the regression artifact that inevitably increases the pretest to posttest gains of students selected for their low pretest scores. The evaluator suggests that in the future, if MACT gain scores of ESAA students are used to assess program effectiveness, that: (a) a control-group design be used, pitting the gains of ESAA students against those of remedial students in non-ESAA schools, similarly selected for low test scores; (b) an attempt be made to estimate probable gains due to regression and adjust the statement of the objective accordingly; and/or (c) some attempt be made to compute a "regression-free," "residual," or "corrected" gain score, using methods suggested by Cronbach and Furby (1969).

Recommendation for the Re-Funding of the Math Component.

The evaluator believes continued funding should be sought for the Math Component, provided recommended program improvements are made. Overall, and in most ESAA schools, Math Component has met its critically important objectives of improving math basic skills among the lowest achieving junior high students in Minneapolis.

Despite some flaws in organization and implementation, the Math Component provided high-interest materials and individual tutoring by aides for large numbers of remedial students. In many of the ESAA schools, the provision of aides and materials filled two important, recognized needs of a compensatory math program--and filled those needs at relatively low cost.

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Appendix A

Minneapolis Public Schools
Department of Mathematics

MINNEAPOLIS ARITHMETIC COMPUTATION TEST
SUMMARY OF RESULTS
GRADE 7--1973-74

Frequency Distribution

| | FALL | | | SPRING | | |
|---|---|---|---|---|---|---|
| Score | Frequency | Cumulative Frequency | Cumulative Per Cent | Frequency | Cumulative Frequency | Cumulative Per Cent |
| 33 | 3 | 4043 | 100.0 | 89 | 3813 | 100.0 |
| 32 | 14 | 4040 | 99.9 | 123 | 3724 | 97.7 |
| 31 | 16 | 4026 | 99.6 | 167 | 3601 | 94.4 |
| 30 | 23 | 4010 | 99.2 | 172 | 3434 | 90.1 |
| 29 | 30 | 3987 | 98.6 | 154 | 3262 | 85.5 |
| 28 | 32 | 3957 | 97.9 | 171 | 3108 | 81.5 |
| 27 | 41 | 3925 | 97.1 | 124 | 2937 | 77.0 |
| 26 | 70 | 3884 | 96.1 | 152 | 2813 | 73.8 |
| 25 | 59 | 3814 | 94.3 | 163 | 2661 | 69.8 |
| 24 | 75 | 3755 | 92.9 | 152 | 2498 | 65.5 |
| 23 | 92 | 3680 | 91.0 | 118 | 2346 | 61.5 |
| 22 | 99 | 3588 | 88.7 | 143 | 2228 | 58.4 |
| 21 | 134 | 3489 | 86.3 | 139 | 2085 | 54.7 |
| 20 | 109 | 3355 | 83.0 | 159 | 1946 | 51.0 |
| 19 | 126 | 3246 | 80.3 | 131 | 1787 | 46.9 |
| 18 | 158 | 3120 | 77.2 | 115 | 1656 | 43.4 |
| 17 | 128 | 2962 | 73.3 | 129 | 1541 | 40.4 |
| 16 | 164 | 2834 | 70.1 | 138 | 1412 | 37.0 |
| 15 | 177 | 2670 | 66.0 | 123 | 1274 | 33.4 |
| 14 | 192 | 2493 | 61.7 | 127 | 1151 | 30.2 |
| 13 | 179 | 2301 | 56.9 | 106 | 1024 | 26.9 |
| 12 | 191 | 2122 | 52.5 | 130 | 918 | 24.1 |
| 11 | 208 | 1931 | 47.8 | 130 | 788 | 20.7 |
| 10 | 208 | 1723 | 42.6 | 103 | 658 | 17.3 |
| 9 | 218 | 1515 | 37.5 | 115 | 555 | 14.6 |
| 8 | 239 | 1297 | 32.1 | 97 | 440 | 11.5 |
| 7 | 238 | 1058 | 26.2 | 93 | 343 | 9.0 |
| 6 | 218 | 820 | 20.3 | 82 | 250 | 6.6 |
| 5 | 186 | 602 | 14.9 | 64 | 168 | 4.4 |
| 4 | 127 | 416 | 10.3 | 38 | 104 | 2.7 |
| 3 | 135 | 289 | 7.1 | 34 | 66 | 1.7 |
| 2 | 83 | 154 | 3.8 | 19 | 32 | .8 |
| 1 | 53 | 71 | 1.8 | 7 | 13 | .3 |
| 0 | 18 | 18 | .4 | 6 | 6 | .2 |

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6/19/74

Appendix A (continued)

Minneapolis Public Schools
Department of Mathematics

MINNEAPOLIS ARITHMETIC COMPUTATION TEST
SUMMARY OF RESULTS
GRADE 8--1973-74

Frequency Distribution

| | FALL | | | SPRING | | |
|---|---|---|---|---|---|---|
| Score | Frequency | Cumulative Frequency | Cumulative Per Cent | Frequency | Cumulative Frequency | Cumulative Per Cent |
| 33 | 36 | 4075 | 100.0 | 131 | 3758 | 100.0 |
| 32 | 67 | 4039 | 99.1 | 192 | 3627 | 96.5 |
| 31 | 70 | 3972 | 97.5 | 181 | 3435 | 91.4 |
| 30 | 108 | 3902 | 95.8 | 206 | 3254 | 86.6 |
| 29 | 111 | 3794 | 93.1 | 229 | 3048 | 81.1 |
| 28 | 135 | 3683 | 90.4 | 213 | 2819 | 75.0 |
| 27 | 134 | 3548 | 87.1 | 191 | 2606 | 69.3 |
| 26 | 136 | 3414 | 83.8 | 188 | 2415 | 64.3 |
| 25 | 140 | 3278 | 80.4 | 182 | 2227 | 59.3 |
| 24 | 153 | 3138 | 77.0 | 183 | 2045 | 54.4 |
| 23 | 150 | 2985 | 73.3 | 142 | 1862 | 49.5 |
| 22 | 153 | 2835 | 69.6 | 130 | 1720 | 45.8 |
| 21 | 169 | 2682 | 65.8 | 135 | 1590 | 42.3 |
| 20 | 149 | 2513 | 61.7 | 129 | 1455 | 38.7 |
| 19 | 140 | 2364 | 58.0 | 131 | 1326 | 35.3 |
| 18 | 150 | 2224 | 54.6 | 119 | 1195 | 31.8 |
| 17 | 159 | 2074 | 50.9 | 115 | 1076 | 28.6 |
| 16 | 145 | 1915 | 47.0 | 99 | 961 | 25.6 |
| 15 | 141 | 1770 | 43.4 | 100 | 862 | 22.9 |
| 14 | 172 | 1629 | 40.0 | 114 | 762 | 20.3 |
| 13 | 147 | 1457 | 35.8 | 118 | 648 | 17.2 |
| 12 | 136 | 1310 | 32.1 | 76 | 530 | 14.1 |
| 11 | 147 | 1174 | 28.8 | 72 | 454 | 12.1 |
| 10 | 165 | 1027 | 25.2 | 76 | 382 | 10.2 |
| 9 | 143 | 862 | 21.2 | 65 | 306 | 8.1 |
| 8 | 151 | 719 | 17.6 | 74 | 241 | 6.4 |
| 7 | 137 | 568 | 13.9 | 44 | 167 | 4.4 |
| 6 | 118 | 431 | 10.6 | 37 | 123 | 3.3 |
| 5 | 95 | 313 | 7.7 | 31 | 86 | 2.3 |
| 4 | 84 | 218 | 5.3 | 26 | 55 | 1.5 |
| 3 | 70 | 134 | 3.3 | 17 | 29 | .8 |
| 2 | 38 | 64 | 1.6 | 4 | 12 | .3 |
| 1 | 21 | 26 | .6 | 5 | 8 | .2 |
| 0 | 5 | 5 | .1 | 3 | 3 | .1 |

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6/19/74

3/74
Form 2M
Card 1

# Appendix B

**Minneapolis Public Schools**
**Student Information Form**
**for ESAA Math Program**


Contact person:
Paul Higgins, Project Evaluator
Tel. 348-6142 or 6140
Minneapolis Public Schools
807 N. E. Broadway
Minneapolis, MN 55413


(1-7) [ ][ ][2][ ][ ][ ][ ] Student's code number (do not fill in)
1 2 3 4 5 6 7

(8) Student's grade placement during 1973-74. Check one:

_____ 7th grade
_____ 8th grade
_____ 9th grade
_____ 1 Other, please specify: _____

(9) Student's sex:

_____ 1 Male
_____ 2 Female

(10) Student's race or ethnic group. Check one:

_____ 1 White American
_____ 2 Black American
_____ 3 Indian American
_____ 4 Spanish-surnamed American
_____ 5 Asian American
_____ 6 Other. Please specify: _____

(11) Did this student ride a bus to school as part of the Minneapolis Public Schools' desegregation plan? Check "Yes" or "No" unless this is a nonpublic school. If a nonpublic school, check Blank 3.

_____ 1 Yes
_____ 2 No
_____ 3 This is a nonpublic school

(12) What type of grading periods (marking periods) does this school have? Check one:

_____ 3 Trimesters
_____ 4 Quarters

Please check below all 1973-74 grading periods (quarters or trimesters) during which this student was ~~continuously~~ enrolled, in this school, in a math class with an ESAA aide and MBSDP materials. (Note: ignore the student's attendance record. Just check periods he/she was "on the rolls.") Check blanks (a) in the left column if you are on the trimester system or (b) in the right column, if on the quarter system.

| | a. Trimesters in 1973-74 | b. Quarters in 1973-74 |
|---|---|---|
| don't keypunch | 1 | 1 |
| | 2 | 2 |
| | 3 | 3 |
| | | 4 |

(13) During the overall total of all 1973-74 grading periods you just checked, did the student attend half (50%) or more of the ESAA math class sessions?

_____ 1 Yes
_____ 2 No

**Student's scores on the MACT (Minneapolis Arithmetic Computation Test).**

a. Fall, 1973

(14-15) [ ][ ] Raw score

(16-17) [ ][ ] Percentile rank in relation to all Minneapolis students at the same grade-level, taking test at the same time.

b. Spring, 1974

(18-19) [ ][ ] Raw score

(20-21) [ ][ ] Percentile rank

c. Subtract fall, 1973, raw score from spring, 1974, raw score:

(22-24) [ ][ ][ ] Raw score difference
Write in + or -

d. Subtract fall, 1973, percentile rank from spring, 1974, percentile rank:

(25-27) [ ][ ][ ] Percentile rank difference
Write in + or -

Student's 1973-74 progress on MBSDP units (see other side):

(28-30) [ ][ ][ ] Total number of Mastery Gain Points earned (from other side, columns 66-67)

(31) [ ] Total number of 1973-74 grading periods student was enrolled (quarters or trimesters; see chart on this page, to left).

(32-34) [ ][ ] . [ ] Divide total points in (28-30) by total grading periods in (31) and round to nearest tenth.

(35-37) [ ][ ] . [ ] (Do not fill in)

(38-39) [ ][ ] % For what percent of his/her total math class time in 1973-74 did this student work on MBSDP materials? (Round to nearest 10%.)

(40-79) Blank

(80) 1=Card number

10

# Appendix B (continued)



Please fill in from columns 1-7 on Page 1:

(1-7) | | | 2 | | | | | Student's code number

1 2 3 4 5 6 7

Student's 1973-74 progress on Mathematics Basic Skills Development Project (MBSDP) units. Progress is measured in "Mastery Gain Points" earned in this school. Please read the chart below and fill in the needed information.

| MBSDP Unit (in parenthesis, number of problems on each pretest and posttest) | Student's Mastery Gain Points: Pretest score (number correct) | Conversion table: For each unit, find pretest score on top line, assign Gain Points from bottom line | | | If posttest passed, Mastery Gain Points earned |
|---|---|---|---|---|---|
| Reading Long Numbers (14) | | 0-4 / 9 | 5-9 / 6 | 10-11 / 3 | (8) |
| Addition of Whole Numbers (21)* | | 0-7 / 15 | 8-13 / 10 | 14-17 / 05 | (9-10) |
| Subtraction of Whole Numbers (22)* | | 0-7 / 15 | 8-14 / 10 | 15-18 / 05 | (11-12) |
| Metric Temperature (14) | | 0-4 / 6 | 5-9 / 4 | 10-11 / 2 | (13) |
| Multiplication of Whole Numbers (20)* | | 0-6 / 21 | 7-12 / 14 | 13-16 / 07 | (14-15) |
| Metric Measurement (linear) (12) | | 0-4 / 15 | 5-7 / 10 | 8-9 / 05 | (16-17) |
| Division of Whole Numbers (Arithmetic Test Generator) (26)* | | 0-9 / 30 | 10-16 / 20 | 17-21 / 10 | (18-19) |
| Division of Whole Numbers (Subtractive approach) (21)* | | 0-7 / 30 | 8-13 / 20 | 14-17 / 10 | (20-21) |
| Division of Whole Numbers (Traditional approach) (21)* | | 0-7 / 30 | 8-13 / 20 | 14-17 / 10 | (22-23) |
| Liquid Measurement (Standard English Units) (22) | | 0-7 / 12 | 8-14 / 08 | 15-18 / 04 | (24-25) |
| Equations (20) | | 0-6 / 15 | 7-12 / 10 | 13-16 / 05 | (26-27) |
| Fractions Concepts (20) | | 0-6 / 15 | 7-12 / 10 | 13-16 / 05 | (28-29) |
| Fractions Unit 1 (11) | | 0-3 / 8 | 4-7 / 4 | 8 / 2 | (30) |
| Fractions Unit 2 (10) | | 0-3 / 6 | 4-6 / 4 | 7-8 / 3 | (31) |
| Fractions Unit 3 (20) | | 0-6 / 12 | 7-12 / 08 | 13-16 / 04 | (32-33) |
| Fractions Unit 4 (12) | | 0-4 / 21 | 5-7 / 14 | 8-9 / 07 | (34-35) |

| MBSDP Unit (in parenthesis, number of problems on each pretest and posttest) | Student's Mastery Gain Points: Pretest score (number correct) | Conversion table: For each unit, find pretest score on top line, assign Gain Points from bottom line | | | If posttest passed, Mastery Gain Points earned |
|---|---|---|---|---|---|
| Linear Measurement (English) (24) | | 0-8 / 21 | 9-15 / 14 | 16-19 / 07 | (36-37) |
| Fractions Unit 5 (16) | | 0-5 / 15 | 6-10 / 10 | 11-13 / 05 | (38-39) |
| Fractions Unit 6 (11) | | 0-3 / 12 | 4-7 / 08 | 8 / 04 | (40-41) |
| Area Measurement (English) (11) | | 0-3 / 21 | 4-7 / 14 | 8 / 07 | (42-43) |
| Volume Measurement (English) (Old Unit) (8) | | 0-2 / 15 | 3-5 / 10 | 6 / 05 | (44-45) |
| Volume Measurement (English) (New Unit) (9) | | 0-3 / 15 | 4-5 / 10 | 6-7 / 05 | (46-47) |
| Decimal Concepts (18) | | 0-6 / 15 | 7-11 / 10 | 12-14 / 05 | (48-49) |
| Metric Capacity (14) | | 0-4 / 6 | 5-9 / 4 | 10-11 / 2 | (50) |
| Adding and Subtracting Decimals (14) | | 0-4 / 6 | 5-9 / 4 | 10-11 / 2 | (51) |
| Multiplying Decimals (11) | | 0-3 / 15 | 4-7 / 10 | 8 / 05 | (52-53) |
| Dividing and Rounding Decimals (Old Unit) (16) | | 0-5 / 42 | 6-10 / 28 | 11-13 / 14 | (54-55) |
| Dividing Decimals (New Unit) (13) | | 0-4 / 21 | 5-8 / 14 | 9-10 / 07 | (56-57) |
| Dividing and Rounding Decimals (New Unit) (11) | | 0-3 / 21 | 4-7 / 14 | 8 / 07 | (58-59) |
| Percent 1 (18) | | 0-6 / 30 | 7-11 / 20 | 12-14 / 10 | (60-61) |
| Percent 2 (20) | | 0-6 / 30 | 7-12 / 20 | 13-16 / 10 | (62-63) |
| Area of Parallelograms and Triangles (16) | | 0-5 / 9 | 6-10 / 6 | 11-13 / 3 | (64) |

*If student took special 10-item tests and units for these math topics, the pretest cutting points are 0-3, 4-6, 7-8. The corresponding Gain Score cutting points are the same as for the MBSDP units.

Total (enter on other side, columns 28-30)

(68-79) Blank

(80) 2=Card number

35

Appendix C

Minneapolis Public Schools

ESAA Math Teacher Form

Your name: _____

Your school: _____

Instructions:

Please answer the questions on the following pages. Your answers will be used (a) to describe how the ESAA Project actually operates, (b) to estimate the Project's effectiveness in meeting objectives, and (c) to make recommendations for improving the Project.

Your answers are anonymous. The following code number will be used instead of your name to identify your answers:

This code, known only to the evaluator, will be used to compare the answers of all ESAA people at the same school. Names of individuals will not appear in any reports, and your answers will not be identified to anyone connected with your employment.

I do need this cover page with your name (a) to determine who has and has not answered the questionnaire and (b) to conduct any needed follow-up.

Do you have any questions?

Now, please remove this cover page and pass it in.

N=43
M=Mean (average)
3/74 S.D.=Standard deviation
Form 3M NR=No response

# Appendix C (continued)

Minneapolis Public Schools

ESAA Math-Teacher Form

Contact person:

Paul Higgins, Project Evaluator
Tel. 348-6142 or 6140
Minneapolis Public Schools
807 N. E. Broadway
Minneapolis, MN 55413

Introductory remarks to Teacher: I have been employed by the Minneapolis Public Schools to help conduct the federally required evaluation of the ESAA Project. I would like to discuss with you frankly the operation of the ESAA Math Component. I would also appreciate your suggestions for improvement of the ESAA Math Component. Names of individuals will not appear in any reports, and your answers will not be identified to anyone connected with your employment.

(1-7) do not fill in: 3 0 2 — Teacher's code number

(8) Sex

26 1 Male 60%
15 2 Female 35%
2 NR 5%

(9) Race or ethnic group

39 1 White American 91%
1 2 Black American 2%
0 3 Indian American 0%
0 4 Spanish-surnamed American 0%
1 5 Asian American 2%
0 6 Other. Please specify: 0%
2 NR 5%

(10-11) How many different math classes did you teach in 1973-74 that contained ESAA students?

M=3.0 S.D.= ±1.5

(12) Did all the ESAA students in your math classes use MBSDP materials?

35 1 Yes 81%
8 2 No 19%

If your answer was "No," please explain why MBSDP materials were not used:

(13) How much interest did the ESAA students show toward the MBSDP materials? Check one:

2 7 Extremely high interest 5%
5 6 Very high interest 12%
14 5 High interest 33%
19 4 Moderate interest 44%
1 3 Slight interest 2%
0 2 Very slight interest 0%
1 1 No interest at all 2%

Do you have any comments, criticisms, or suggestions concerning the MBSDP materials (Units and Tests)?

1 NR 2%

(14) Did you have enough MBSDP materials (Units and Tests) for all of your ESAA students?

31 1 Yes 72%
10 2 No 23%

Describe any insufficiencies in your supply of MBSDP materials:

2 NR 5%

How were the MBSDP materials used with ESAA students?

(15) How often were the materials used? Check one:

16 5 Once a day 37%
19 4 Between 2 and 4 times per week 44%
3 3 About once a week 7%
1 2 About once every two weeks 2%
2 1 Less often than once every two weeks 5%
2 0 Never 5%

When MBSDP units were assigned, were the assignments made to:

(16) Students as individuals?

36 1 Yes 84%
3 2 No 7%
4 NR 9%

(17) Students in small groups?

7 1 Yes 16%
20 2 No 46%
16 NR 37%

(18) Whole classes at once?

14 1 Yes 33%
17 2 No 40%
12 NR 28%

Please give any suggestions or "tips" you would make for the effective use of MBSDP materials with ESAA students:

(19) Do you use other materials, besides MBSDP materials, in teaching the areas of math basic skills?

40 1 Yes 93%
3 2 No 7%

If "Yes," please describe the materials and the students' reactions:

(20) Did you participate in any pre-service or in-service training program designed to help you use the MBSDP materials?

| | | |
|---|---|---|
| 34 | 1 Yes | 79% |
| 5 | 2 No | 12% |

Please describe any such training program:

4 NR 9%

(21) If you answered "Yes" to (20), please rate the training program's effectiveness in preparing you to use the MBSDP materials.

| | | |
|---|---|---|
| 6 | 6 Excellent | 14% |
| 13 | 5 Very good | 30% |
| 7 | 4 Good | 16% |
| 9 | 3 Fair | 21% |
| 0 | 2 Poor | 0% |
| 0 | 1 Very poor | 0% |

Please describe your criticisms of the training and/or suggest improvements in the training:

8 NR 19%

(22) How would you describe your working relationship with the ESAA Math Teacher-Aide(s) who assist you?

| | | |
|---|---|---|
| 20 | 6 Excellent | 46% |
| 12 | 5 Very good | 28% |
| 5 | 4 Good | 12% |
| 1 | 3 Fair | 2% |
| 2 | 2 Poor | 5% |
| 0 | 1 Very poor | 0% |

If you feel the relationship(s) could be improved, describe how improvement might be made:

3 NR 7%

(23) Do you know of any ESAA-eligible student(s) in your school who were <u>not</u> enrolled in a math class with an ESAA Math Aide and MBSDP materials?

| | | |
|---|---|---|
| 16 | 1 Yes | 37% |
| 21 | 2 No | 49% |

If you answered "Yes," please give the number of such students and explain their lack of participation in the ESAA Math Component:

6 NR 14%

(24) Do you think the ESAA Math Component--which includes Math Aides and MBSDP materials--should be changed in any way next year in your school?

| | | |
|---|---|---|
| 17 | 1 Yes | 40% |
| 14 | 2 No | 33% |
| 8 | 3 Uncertain | 19% |

If you answered "Yes" or "Uncertain," please explain:

4 NR 9%

(25-79) Blank

(80) 1-Card number

3/74
Form 4M



Appendix D

Minneapolis Public Schools
ESAA Math Aide Form

Your name: _____

Your school: _____

Instructions:

Please answer the questions on the following pages. Your answers will be used (a) to describe how the ESAA Project actually operates, (b) to estimate the Project's effectiveness in meeting objectives, and (c) to make recommendations for improving the Project.

Your answers are anonymous. The following code number will be used instead of your name to identify your answers:

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |

This code, known only to the evaluator, will be used to compare the answers of all ESAA people at the same school. Names of individuals will not appear in any reports, and your answers will not be identified to anyone connected with your employment.

I do need this cover page with your name (a) to determine who has and has not answered the questionnaire and (b) to conduct any needed follow-up.

Do you have any questions?

Now, please remove this cover page and pass it in.

N=24
M=Mean (average)
3/74 S.D.=Standard deviation
Form 4M NR=No response

# Appendix D (continued)

Minneapolis Public Schools

ESAA Math-Aide Form

Contact person:
Paul Higgins, Project Evaluator
Tel. 348-6140
Minneapolis Public Schools
807 N. E. Broadway
Minneapolis, MN 55413

Introductory remarks to Aide: I have been employed by the Minneapolis Public Schools to help conduct the federally required evaluation of the ESAA Project. I would like to discuss with you frankly the role of the ESAA Math Aide. I would also appreciate your suggestions for improvement of the ESAA Math Component. Names of individuals will not appear in any reports, and your answers will not be identified to anyone connected with your employment.

(1-7) do not fill in [ ][ ][ ][ ][ ][ ][ ] Aide's code number
1 2 3 4 5 6 7

(8) Sex

2 1 Male 8%
22 2 Female 92%

(9) Race or ethnic group

17 1 White American 71%
6 2 Black American 25%
0 3 Indian American
0 4 Spanish-surnamed American
0 5 Asian American
1 6 Other. Please specify: 4%

(10-11) [ ][ ] How many different math classes did you assist in 1973-74 that contained ESAA students?
M=5.4, S.D.=+3.9

(12-13) [ ][ ] How many different classes did you assist in 1973-74 that did not contain any ESAA students?
M=0.6, S.D.=+1.6

(14-15) [ ][ ]% Of the total time you spent working face-to-face with students, what percent of this time did you spend working with ESAA students? (Round to nearest 10%.)
M=73%, S.D.=+26%

(16) Did all the ESAA students in your math classes use MBSDP materials?

15 1 Yes 62%
8 2 No 33%

If your answer was "No," please explain why MBSDP materials were not used:

1 NR 4%

(17) How much interest did the ESAA students show toward the MBSDP materials? Check one:

1 7 Extremely high interest 4%
8 6 Very high interest 33%
5 5 High interest 21%
8 4 Moderate interest 33%
0 3 Slight interest 0%
0 2 Very slight interest 0%
1 1 No interest at all 4%

Do you have any comments, criticisms, or suggestions concerning the MBSDP materials?

1 NR 4%

(18) Do you now perform any duties that you feel you should not perform?

2 1 Yes 8%
22 2 No 92%

If you answered "Yes," please describe the activities:

(19) Are there duties you don't perform that you feel you should be performing as a Math Aide? Are there things you don't do that you should be doing?)

1 1 Yes 4%
23 2 No 96%

If you answered "Yes," please describe the activities:

(20) How would you describe your working relationship with the teacher(s) you assist? Check one:

14 6 Excellent 58%
7 5 Very good 29%
3 4 Good 13%
0 3 Fair 0%
0 2 Poor 0%
0 1 Very Poor 0%

If you feel the relationship(s) could be improved, describe how improvement might be made:

(21) Do you think the ESAA Math Component--which includes Math Aides and MBSDP materials--should be changed in any way next year in your school?

10 1 Yes 42%
11 2 No 46%
1 3 Uncertain 4%

If you answered "Yes" or "Uncertain," please explain:

2 NR 8%

# Appendix D (continued)



The role of the Math Aide: listed below are some activities that Math Aides might perform. For each activity please indicate (a) Do you perform the activity? (b) How do you perform the activity? (c) What % of your total time do you estimate you spend on this activity?

| Activity | Do you perform the activity? | How do you perform the activity? (Include any "tips" you would give to others wanting to help ESAA students master mathematics.) | What % of your total time do you spend on this activity? (Round to nearest 5%.) |
|---|---|---|---|
| 1. Passing out and collecting math materials. | (22) 22 1 Yes 2 2 No | 92% 8% | (33-34) M 04 % ± 4 |
| 2. Helping individual students to do their work. | (23) 23 1 Yes 1 2 No | 96% 4% | (35-36) 42 % ±26 |
| 3. Helping small groups of students to do their work. | (24) 22 1 Yes 2 2 No | 92% 8% | (37-38) 14 % ±18 |
| 4. Passing out and monitoring tests. | (25) 22 1 Yes 2 2 No | 92% 8% | (39-40) 04 % ± 5 |
| 5. Giving feedback to students concerning their classroom performance. | (26) 20 1 Yes 4 2 No | 83% 17% | (41-42) 04 % ± 5 |
| 6. Selecting, finding, or writing materials to supplement the MBSDP materials. | (27) 10 1 Yes 14 2 No | 42% 58% | (43-44) 04 % ± 6 |
| 7. Assisting the classroom teacher in lesson planning. | (28) 6 1 Yes 18 2 No | 25% 75% | (45-46) 01 % ± 2 |
| 8. Organizing and storing the MBSDP materials (including ordering of materials). | (29) 14 1 Yes 10 2 No | 58% 42% | (47-48) 02 % ± 4 |
| 9. Scoring tests and other written materials. | (30) 23 1 Yes 1 2 No | 96% 4% | (49-50) 10 % ±11 |
| 10. Maintaining student records (including unit completions, test scores, grades, attendance). | (31) 20 1 Yes 4 2 No | 83% 17% | (51-52) 07 % ± 5 |
| 11. Do you perform any other activities as an ESAA Math Aide? | (32) 15 1 Yes 9 2 No | List these "other" activities: 63% 38% | (53-54) 08 % ±17 |

*After your first answers on this section, you may need to revise the %'s, so Total is 100%.

Total 100%

47

(55-79) Blank

(80) 1 Card number

Minneapolis Public Schools

Educational Services Division

Planning, Development and Federal Programs

Harry N. Vakos, PhD., Assistant Superintendent

Educational Services

## Planning and Development

Lawrence P. Moon, PhD., Director of Planning, Development and Federal Programs

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